# Re-Engineering/Reconstruction of Railcars for Forest Operations

Oregon COFE Conference

1/18/2017

Lone Rock Timber Management Co:

Ken Hoffine – PE, PLS

Weston Addington – EI, LSI

# Introduction

*Ken Hoffine* – Operations Manager, PE, PLS.WRE

Lone Rock Timber Management Co., Lone Rock Logging Company

1979 Forest Engineering graduate from Oregon State University

*Weston Addington* – Forest Engineering Assistant, EI, LSI

Lone Rock Timber Management Co.

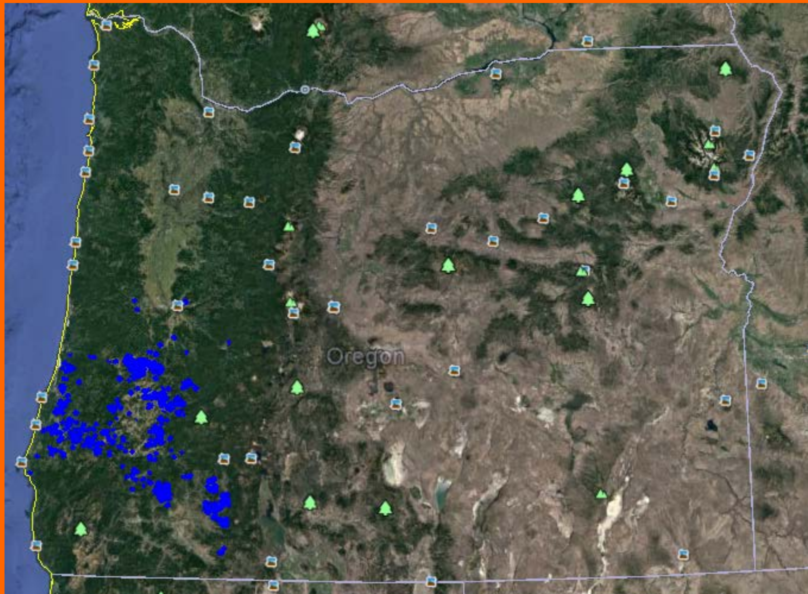
2014 Forest Engineering/Civil Engineering duel-degree graduate from Oregon State University

# About Lone Rock Resources

- Family owned company by the Sohn family
- Originally founded in 1950 as Sun Studs Mill (later changed to Lone Rock)
- Now owns & manages nearly 130,000 acres of timberlands

Lone Rock Resources is comprised of:

- Lone Rock Timber Management Co
  - -Engineering/Surveying
  - -Inventory
  - -Reforestation
  - -Log Sales
- Lone Rock Logging
  - -2 cable & 1 ground based logging sides
  - -4 road construction sides
  - -2 road surfacing sides
  - -Lowboy and logging trucks
  - -Full road maintenance crew in Winter
  - -Logging maintenance & fabrication shop
  - -8 Hand Cutters, Hotsaw, Tethered Barsaw



# Lone Rock Roads Program

- Lone Rock has approx. 1500 miles of roads in which it manages
- Construct/reconstruct between 30 and 35 miles every year
- On-going road inventory program, inspect roads every 4 years (25% per year)

- New bridge inventory system with a bridge inspection on each of our bridges
- We have discovered 91 bridges within our roads system, 70 of them are fully or partially owned and managed by Lone Rock

# Why do we need to talk about bridges?

- Bridges are an essential part road transportation and timber hauling
- As Engineers we are tasked with protecting the health, safety, and welfare of the public
- Bridges are often neglected due to irregular use, maintenance difficulty, and high costs
- Neglected bridges can sometimes equate to dangerous situations (bridge failures)

# Why is Lone Rock talking about bridges?

- Lone Rock is not a bridge manufacturing company, it is a timber company
- However, there is still a need for an economical approach to bridge crossings
- Approx. 1/3 of our bridges are old railcars
- Wood decking was used when large timber was readily available and cheap

- Lone Rock has a priority of safety, economics, longevity, and timber harvest access
- As a small timber company we are mindful of our available resources (concrete bridge slabs, railcars, large I-beams, etc…) and we should use them when appropriate
- Lone Rock has experimented with railcar re-engineering and reconstruction on two bridges in 2017 on the Raia and J220634 timber tracts

# Should we re-use old bridges?

Yes and no…

You must evaluate your materials:

- Railcar: Was the railcar in a wreck? Are there observable cracks? Is there any bending in the car? Was the railcar overstressed with previous bridge crossing (extended past truck axles)?
- Concrete: Is there cracking in the concrete? How much reinforcement in concrete?
- Steel: Are the beams bent? How much rust is on the beam?

# Should railcars be used for bridges?

Railcars are a resource which has been continually misused.

Railcars are not a one size fits all bridge and should be used with caution.

But why are they used?? Because they were often cheap and readily available at the time and are still in many places today.

Lone has its own Engineering staff, logging shop steel fabrication, and road crew personnel. This puts Lone Rock in a unique situation where we have the capability to reconstruct an existing bridge structure.

# Railcar pre-cautionary measures

Do we replace the railcar bridge or try to reinforce it?

Railcars which show deterioration with bent beams or cracking should not be used!

Railcars were originally engineered to carry loads between axles on a railway.

Therefore, they should not carry loads on spans greater than the truck axle distance.

How is the decking distributing the load among the load carrying members of the railcar?

There is an unknown load capacity for most railcars, so we must be careful to not overload them.

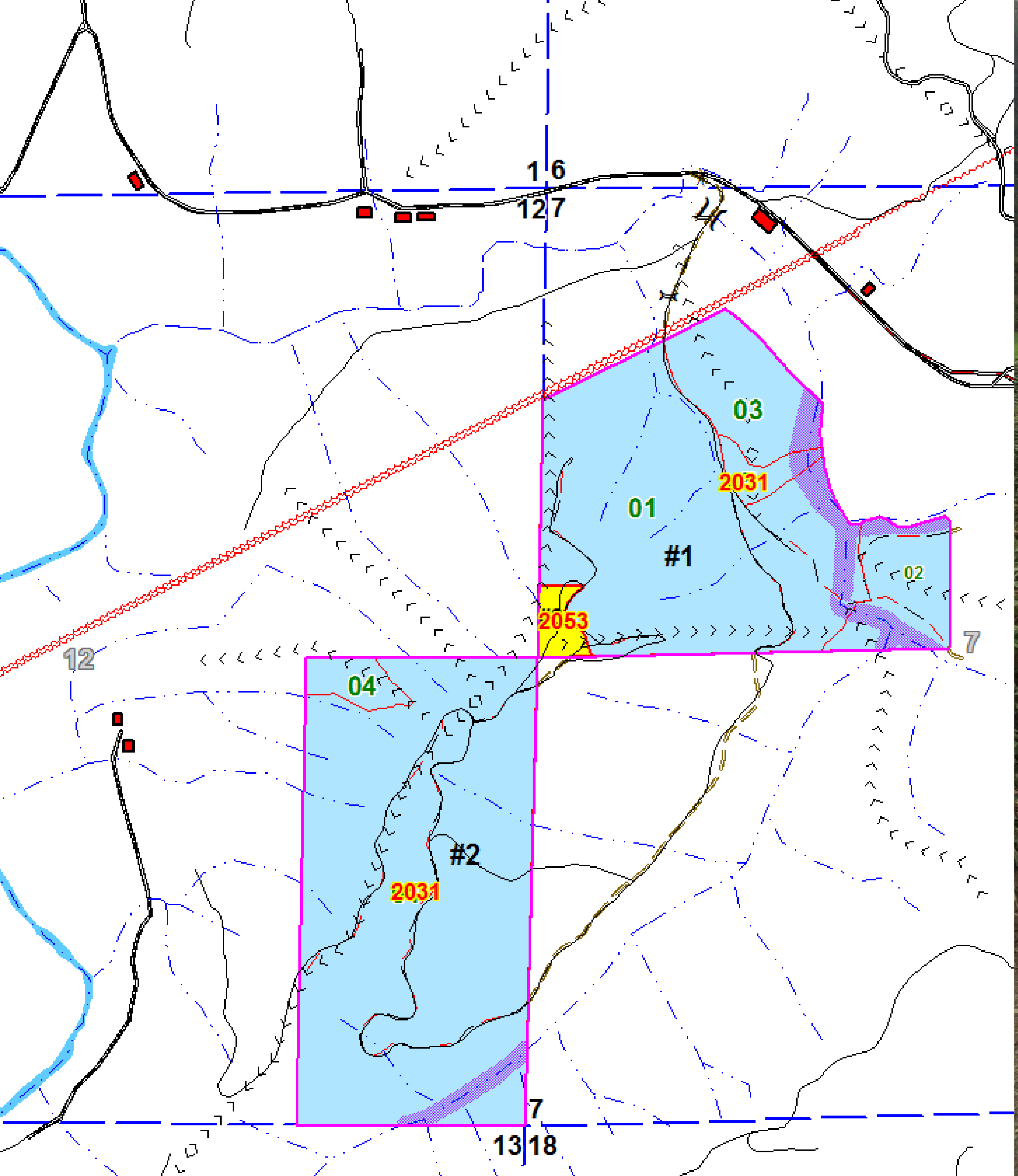
We should avoid re-using railcars without reinforcing them.

Our goal has been to double the factor of safety (at a minimum) when reinforcing railcars.

# An example of what not to re-use

# Raia Bridge Project

- Existing easement through previous owner of tract (neighbor) farm fields
- Property purchase agreement requires Lone Rock to provide permanent bridge access for neighbor and his hauling purposes (typically hay trucks)
- Old bridge is an 89’railcar with rotten log abutments
- Existing railcar has small I-beam cross beams along entire 76 ft. deck length
- Railcar was previously installed past its truck axles to a span of greater than 70 ft.
- Bridge is too low, the creek has flooded to the bridge elevation in the past
- Decaying wood deck with several holes (safety hazard!)
- Electricity line 25 ft. above bridge
- Irrigation line running across bridge for hay fields
- Farm gate for cows
- The bridge must be reconstructed for existing farm use and future timber haul (10+ years for Lone Rock)
- Extreme concern for liability of neighbor hauling hay and cattle trucks across bridge without notice to Lone Rock


1 6
12 7
03
2031
01
#1
02
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7
12
04
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2031
7
13 18

# Raia Bridge Primary Goals

- Bridge must support full span of loaded low boy with yarder (heaviest equipment for Lone Rock design load)
- Shorten bridge span to truck axle span of 66.5 ft. (to decrease the moment of the load)
- Construct concrete abutments to support both ends of bridges
- Raise bridge height to be above the flood level
- Add W36x150 beam to each side of railcar to increase bridge strength
- Weld ½” steel deck (14’x76’) across W36x150 beams and railcar to tie all members together and distribute load

- Do this all at as low of a cost as possible. There will be no timber hauled out of Raia for another 10 years

# Raia Bridge Project Partners

Project Partners:

- Lone Rock Timber Management Co. surveyed the bridge site and made initial designs
- McGee Engineering Inc. performed engineering computations on the decking, cross beams, and span I-beam members. Also created reconstruction installation specifications
- Lone Rock Logging constructed the abutments, installed the I-beams, and installed the bridge
- Billeter Marine, LLC welded the bridge and deck together. Certified to butt-weld used I-beams together.

# Bridge Site Survey

Size of structure depends on watershed tributary area and th

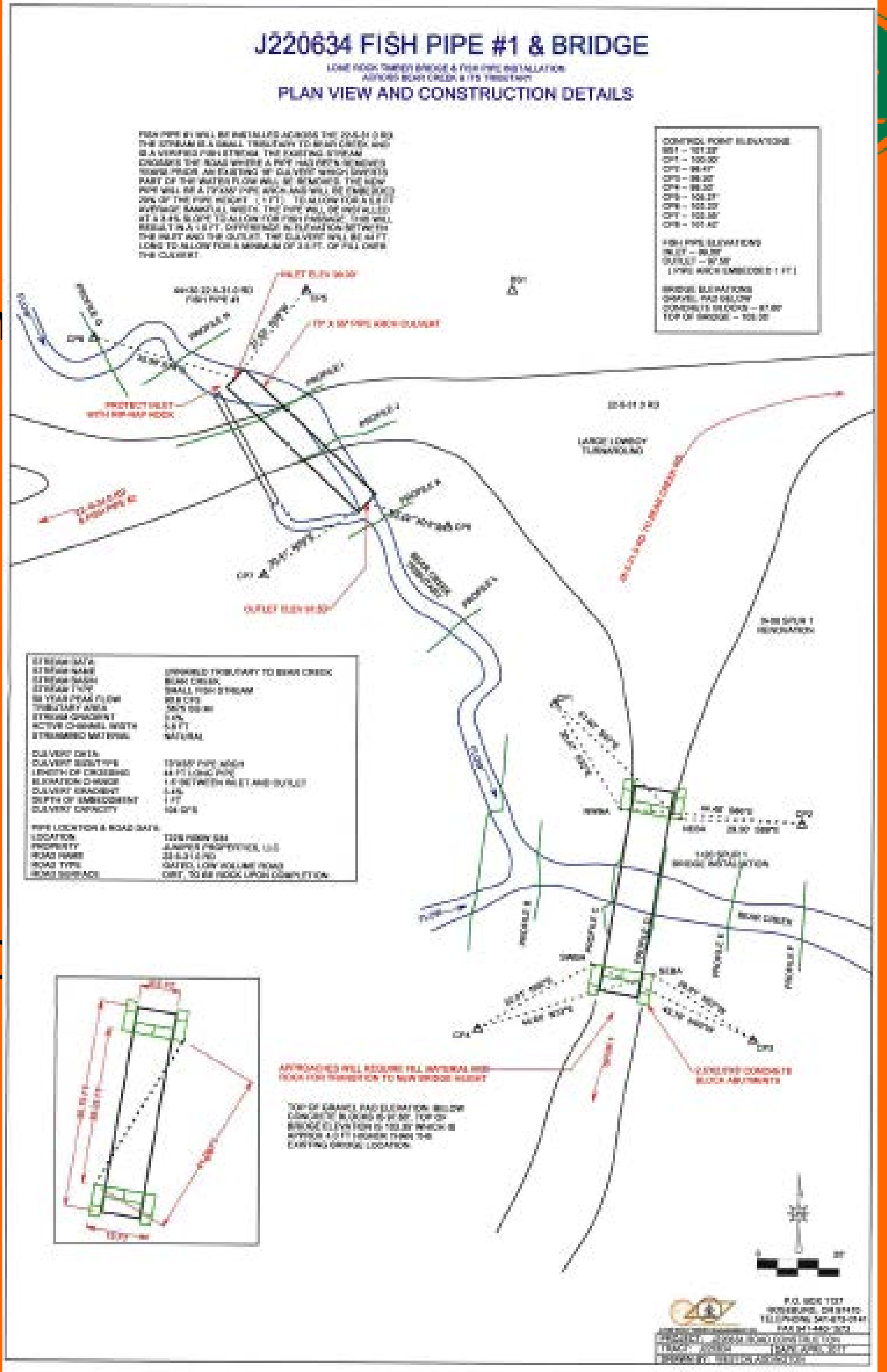
(50 yr. flood event in Oregon)

- Field Work: Need a topographic survey of site

1. Cross sections of stream
2. Road profile
3. Abutment locations, look for control points
4. Any observations which may effect the design

- Office Work: Use MapInfo or ArcGIS, Traverse PC, & VisualC

1. Stream grade
2. Stream width (Mean High Water)
3. 50 Year Peak Flow

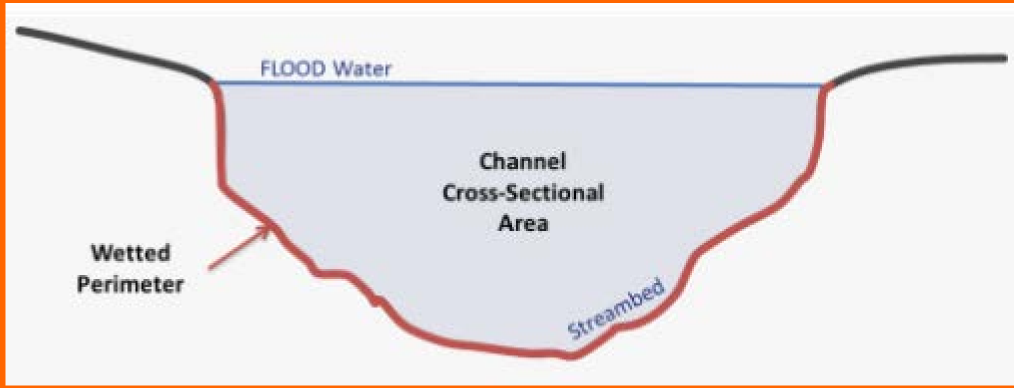


# Engineering

Determine the 50 yr. flood level using surveyed cross sections and Manning's Equation:

$$Q = \frac{1.486}{n} R^{2/3} S^{1/2}$$

- Q = flow rate ($ft^3/s$)
- n = coefficient of roughness
- R = Hydraulic Radius (Area/Wetted Perimeter)
- S = slope




Compare to ODF 50 year peak flow for forest streams.

ODOT Hydraulics Manual requires that the lowest point of bridge be 2 ft. higher than flood level.

# Engineering (McGee Engineering)

Design bridge for load rating:

- Typical log truck: 80,000 lbs
- Rock Trucks: HS20 or HL93 50,000 lbs
- U102 Lowboy Overload: 102.5 tons
- L90 Tracked Overload: 90 tons

Design Methods:

Shear and Moment Diagrams

- Span distance
- Loading with Safety Factor: LRFD method is common
  - Load = 1.2DL +1.6LL

Design Parameters:

- Span length decision: Cost of superstructure is often less than the cost of constructing the substructure
- Substructure: Wing walls required? Soil stability? Pile driving? Geotechnical concerns?
- Take preventative measures!

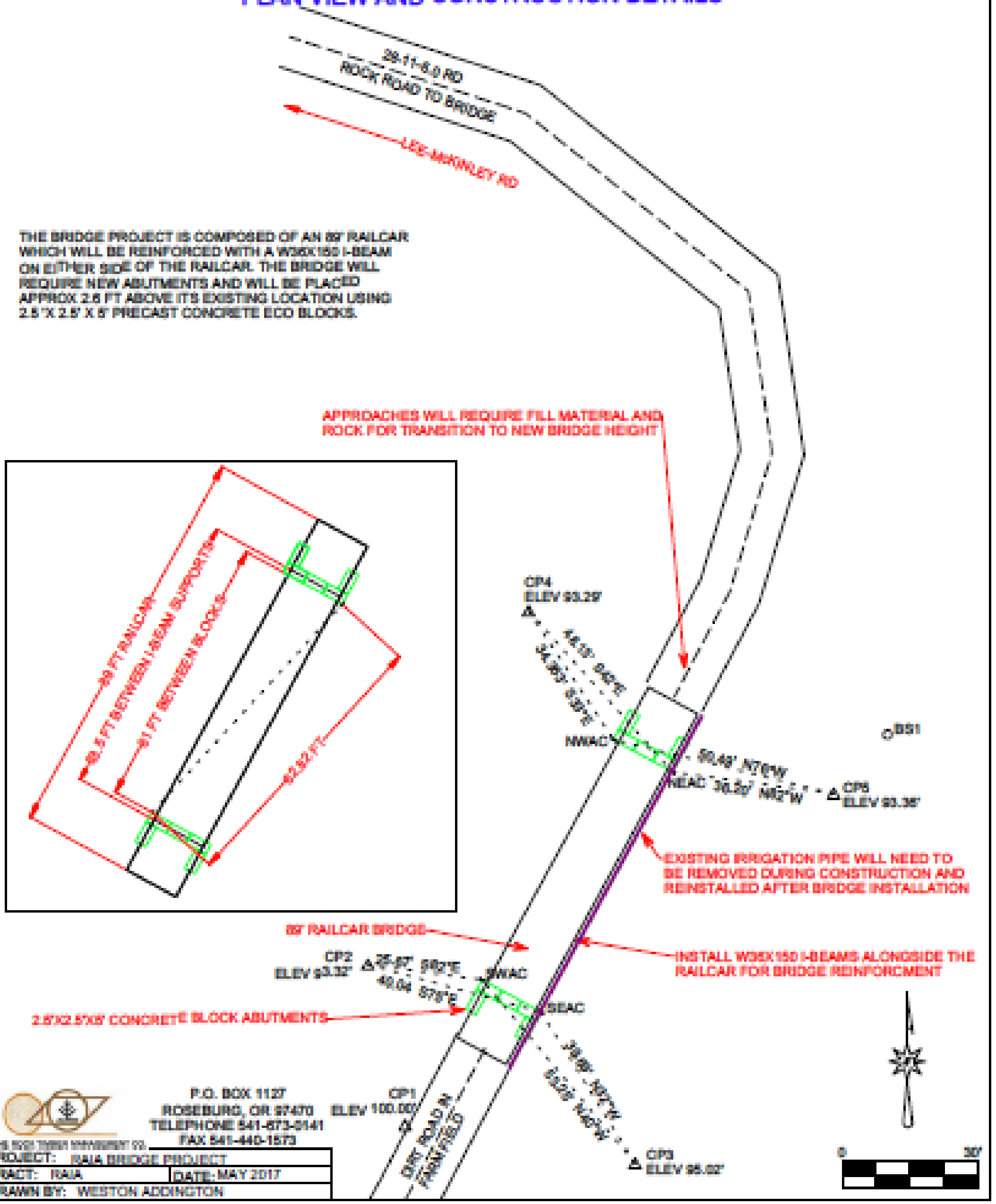
Use the tools in your toolbox. Talk to the professionals when this is outside your field of expertise.

# RAIA BRIDGE PROJECT

LONE ROCK TIMBER BRIDGE INSTALLATION
ACROSS MIDDLE CREEK, TRIBUTARY OF NORTH FORK COQUILLE RIVER

## PLAN VIEW AND CONSTRUCTION DETAILS

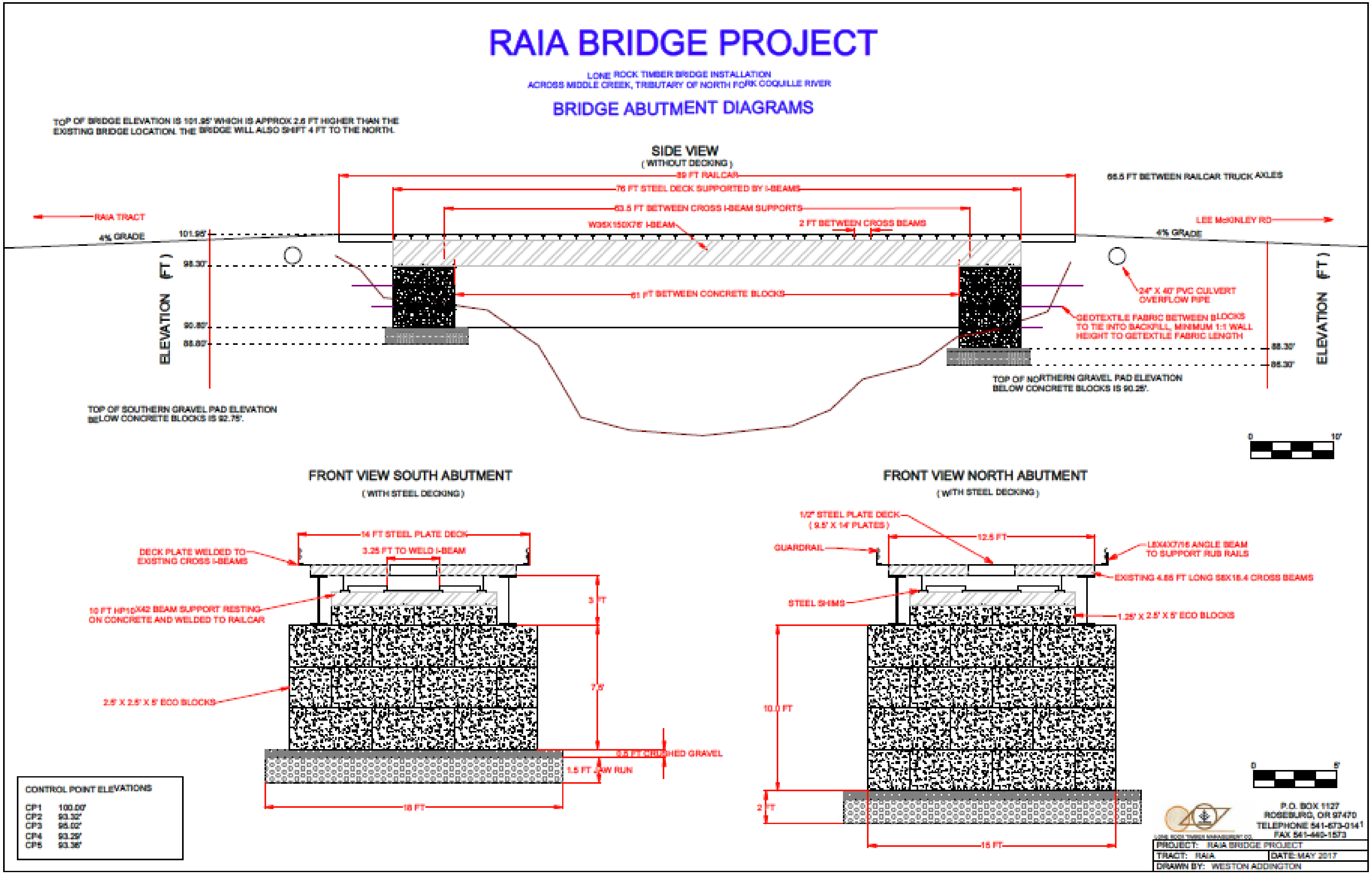
THE BRIDGE PROJECT IS COMPOSED OF AN 89' RAILCAR WHICH WILL BE REINFORCED WITH A W36X150 I-BEAM ON EITHER SIDE OF THE RAILCAR. THE BRIDGE WILL REQUIRE NEW ABUTMENTS AND WILL BE PLACED APPROX 2.5 FT ABOVE ITS EXISTING LOCATION USING 2.5'X 2.5' X 5' PRECAST CONCRETE ECO BLOCKS.

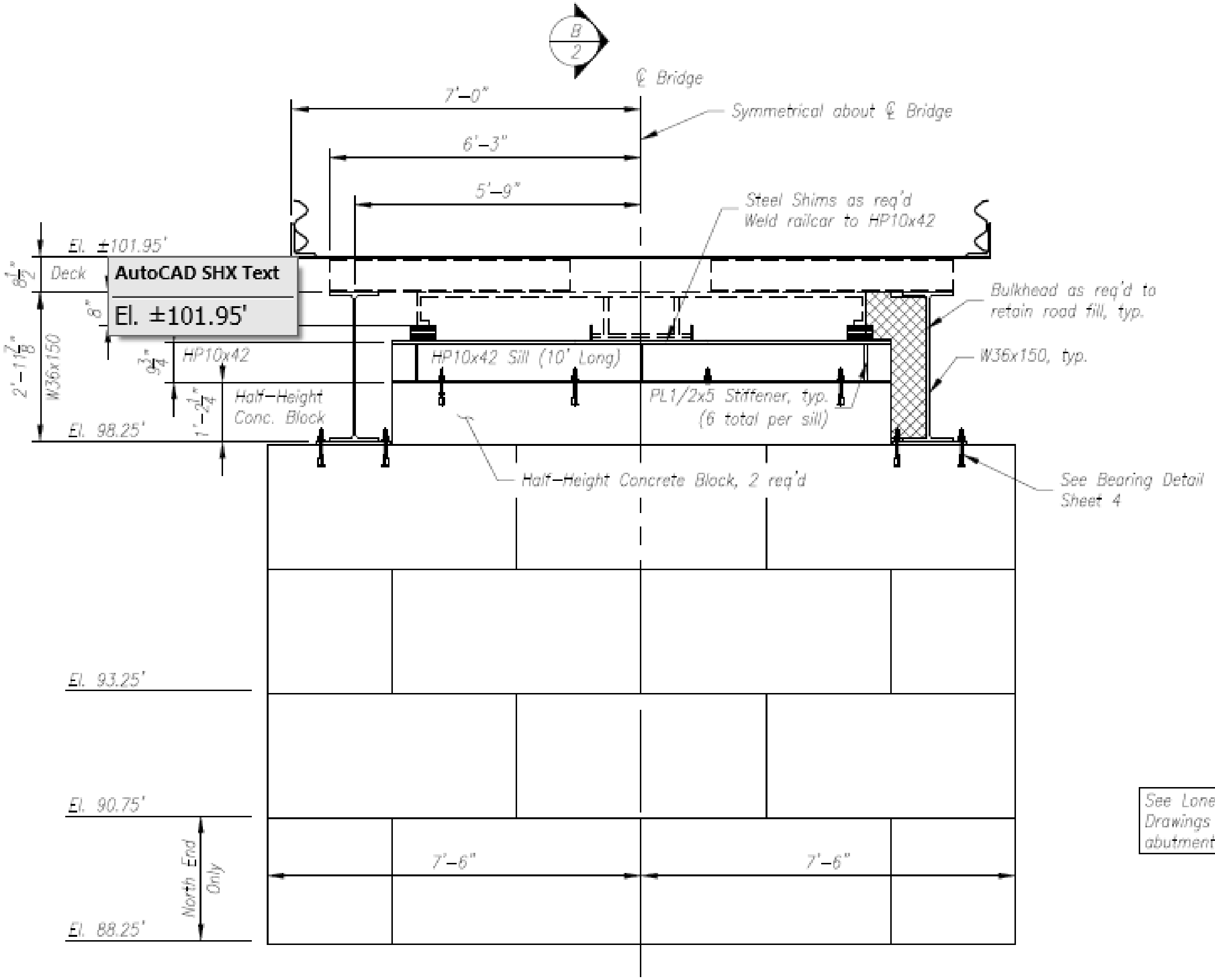




P.O. BOX 1127
ROSEBURG, OR 97470
TELEPHONE 541-673-0141
FAX 541-440-1573

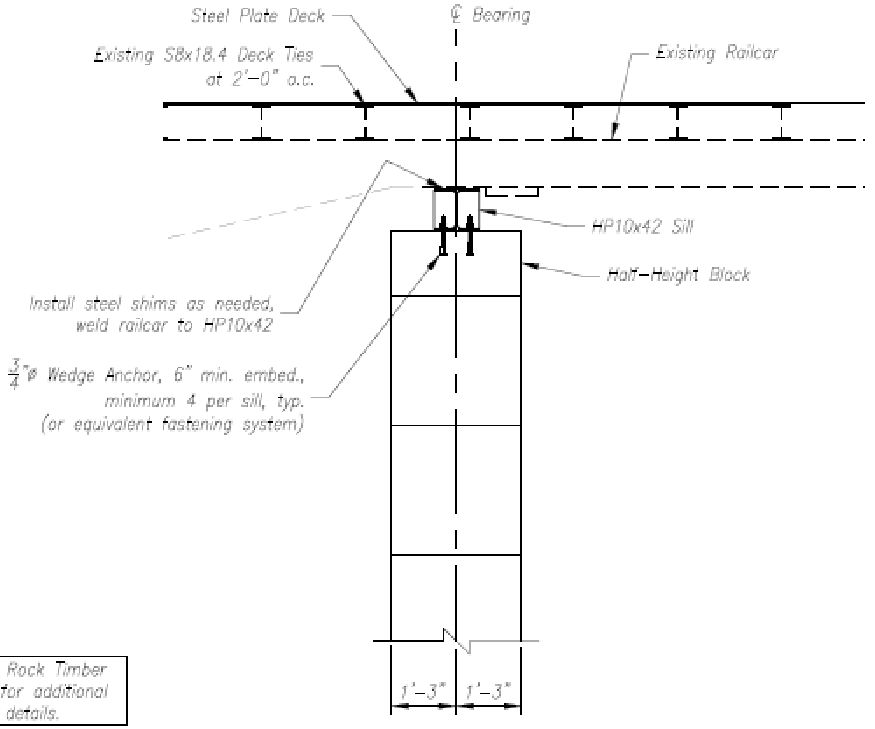

| | |
|---|---|
| PROJECT: RAIA BRIDGE PROJECT | |
| TRACT: RAIA | DATE: MAY 2017 |
| DRAWN BY: WESTON ADDINGTON | |


RAIA BRIDGE PROJECT
LONE ROCK TIMBER BRIDGE INSTALLATION
ACROSS MIDDLE CREEK, TRIBUTARY OF NORTH FORK COQUILLE RIVER
BRIDGE ABUTMENT DIAGRAMS
TOP OF BRIDGE ELEVATION IS 101.95' WHICH IS APPROX 2.6 FT HIGHER THAN THE EXISTING BRIDGE LOCATION. THE BRIDGE WILL ALSO SHIFT 4 FT TO THE NORTH.
SIDE VIEW
( WITHOUT DECKING )
89 FT RAILCAR
76 FT STEEL DECK SUPPORTED BY I-BEAMS
63.5 FT BETWEEN CROSS I-BEAM SUPPORTS
66.5 FT BETWEEN RAILCAR TRUCK AXLES
RAIA TRACT
LEE McKINLEY RD
W36X150X76' I-BEAM
2 FT BETWEEN CROSS BEAMS
4% GRADE
4% GRADE
101.95'
98.30'
90.80'
88.80'
88.30'
86.30'
ELEVATION (FT)
ELEVATION (FT)
61 FT BETWEEN CONCRETE BLOCKS
24" X 40' PVC CULVERT OVERFLOW PIPE
GEOTEXTILE FABRIC BETWEEN BLOCKS TO TIE INTO BACKFILL, MINIMUM 1:1 WALL HEIGHT TO GETEXTILE FABRIC LENGTH
TOP OF NORTHERN GRAVEL PAD ELEVATION BELOW CONCRETE BLOCKS IS 90.25'.
TOP OF SOUTHERN GRAVEL PAD ELEVATION BELOW CONCRETE BLOCKS IS 92.75'.
0
10'
FRONT VIEW SOUTH ABUTMENT
( WITH STEEL DECKING )
14 FT STEEL PLATE DECK
3.25 FT TO WELD I-BEAM
DECK PLATE WELDED TO EXISTING CROSS I-BEAMS
10 FT HP10X42 BEAM SUPPORT RESTING ON CONCRETE AND WELDED TO RAILCAR
2.5' X 2.5' X 5' ECO BLOCKS
3 FT
7.5'
0.5 FT CRUSHED GRAVEL
1.5 FT JAW RUN
18 FT
FRONT VIEW NORTH ABUTMENT
( WITH STEEL DECKING )
1/2" STEEL PLATE DECK
( 9.5' X 14' PLATES )
12.5 FT
GUARDRAIL
L6X4X7/16 ANGLE BEAM TO SUPPORT RUB RAILS
EXISTING 4.85 FT LONG S8X18.4 CROSS BEAMS
STEEL SHIMS
1.25' X 2.5' X 5' ECO BLOCKS
10.0 FT
2 FT
15 FT
0
5'
CONTROL POINT ELEVATIONS
CP1 100.00'
CP2 93.32'
CP3 95.02'
CP4 93.29'
CP5 93.36'
P.O. BOX 1127
ROSEBURG, OR 97470
TELEPHONE 541-673-0141
FAX 541-440-1573
PROJECT: RAIA BRIDGE PROJECT
TRACT: RAIA
DATE: MAY 2017
DRAWN BY: WESTON ADDINGTON




A/2 Section near ℄ Brg.

Scale: 3/8" = 1'–0"




See Lone Rock Timber Drawings for additional abutment details.

B/2 Section near ℄ Bridge

Scale: 3/8" = 1'–0"

| Rev | Description | By | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |


McGee Engineering Inc.
P.O. Box 1067
Corvallis, OR 97339
Phone: (541) 757–1270
Fax: (541) 758–6585


Measures one inch on original drawing. Adjust scales accordingly.

REGISTERED PROFESSIONAL ENGINEER 72565PE OREGON DECEMBER 31, 2007 ALEXANDER J. DUNN

Digitally signed by Alexander J Dunn
Date: 2017.05.19 15:36:26-07'00'

Renewal: 12/31/2017

Lone Rock Timber Mgmt. Co.

Raia Bridge Project
Over Middle Creek

Bridge Sections – 1

| | |
|---|---|
| Designed: A. Dunn | Date: 5–19–2017 |
| Drawn: A. Dunn | Sheet 2 of 4 |

# Written Plan

Bridge construction on forest lands requires a written plan when there is in water work for timber management purposes. A typical written plan includes:

- Construction Period (typically July 1st – September 15th)
- Type of Structure (pipe or bridge)
- Basin Acreage (watershed size)
- 50 Year Peak Flow ($ft^3/s$)
- Stream Classification (type and size of stream)
- Fish Passage Provision (will pumping be necessary?)

We typically provide a plan and profile view of the bridge site and the location of the low water crossing

# Bridge Installation

Before we could begin…

- Need to construct a temporary low water crossing (wait until low water period in July)
- In some cases use clean rock in stream to reduce erosion in the stream
- Seed and mulch crossing when done


CAT

# Bridg

- W36x150 beam ... ed by ODOT on Sellwood Bridg
- Many of the ex ... ting, cleaning, and welding to
- ½” steel deckin ... teel in future)
- Rubrails were c ... ” tall, minimum 9” rails require


CAT



IT28F
CAT


# Budget Review

Cost Notes:

- Same cost for abutment construction
- Longevity of a steel deck vs timber deck

Cost of reinforced railcar:

| | |
|---|---|
| Steel Supplies | $27,387 |
| Fabrication | $27,307 |
| Rock & Foundation Supplies | $22,595 |
| Installation | $57,947 (rental 245 Excavator, 225 excavator, generator, shovel, trucks, etc…) |
| Engineering | $2826 |
| Misc. Costs | $6002 (watchman, irrigation supplies, culverts) |
| Total Cost | $144,064 |

# Budget Review

Perspective:

Quoted bridge cost of $85,000 for 70 ft. bridge

$85,000+Rock & Foundation + Installation + Engineering + Misc. Costs = $174, 371

Estimated $30,000 in savings (without taking a crane rental into account)

# LRT Results from 2017 Bridge Installations

Should other companies be reconstructing bridges?

Lone Rock is in a unique situation as we have our own:

- Engineering/Surveying Department
- Cooperative relationship with bridge engineering consultant
- Available labor and operators with our Road Crews
- Welders and fabricators from the Lone Rock Shop

# LRT Future Bridge Plans

Minimize railcar use and begin installing new bridges

- Custom I-beam bridges (typically 30-50’)
- Concrete bridge option for short spans (<27’)
- Concrete slab re-decking for an existing bridge
- Tethered system for moving across large streams with poor access

# LRT Future Bridge Challenges

F240118 Bridge on Rock Creek

- Short railcar was placed above log stringer bridge
- Poor access
- Road has curved approaches
- Need 70 ft. new bridge
- Considering an I-beam bridge option

Lone Rock would like to experiment with using our new tethered system for bridge construction on long spans as opposed to large excavators or cranes.

# Thank you for your time!